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ON THE EDUCATIONAL GOALS OF INNOVATION AND EMPLOYABILITY*

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Introduction

In this chapter we argue that while the dominant discourse surrounding 'innovation' and 'employability', harbours some unfortunate economistic aspects, science educators can co-opt the two concepts and frame them in a way that is pedagogically meaningful.

There is an increasing focus among policy-makers on fostering students' employability. Many argue that education must contribute to the development of society in general and the economic growth in particular (Cerych & Furth, 2011; Trow, 2010). Further, students should become able to transform their capacities and competences into the demands of the labour-market (European-Commission, 2011). Indeed, politicians have employed so-called 'employability indicators' to measure the performance of education institutions (Knight & Yorke, 2013).

There is a similar trend for fostering students' innovation (Nielsen, forthcoming). The ability to be innovative is seen by many as the key to sustained economic welfare (EU-Commission, 2010; White House, 2011). Further, many argue that in order to secure a certain degree of innovation competency among the future generation, education for innovation requires new aspects of educational systems that "complement formal education" (OECD, 2010, p. 3). Indeed, innovation will be a potential goal for all educational levels and in most of the existing individual disciplines (e.g. Danish Government, 2012; Finnish Government, 2009; Nordic Council of Ministers 2011; Commonwealth of Australia, 2009; White House, 2011).

This consistent discourse about education for employability and innovation notwithstanding, it is not always clear what the terms are taken to signify. For example, here three suggested definitions of innovation that have slight but important differences:

- "innovation, by definition, involves creating and marketing of the new" (Kline & Rosenberg, 1986, p. 275).
- "Innovation processes involve the exploration and exploitation of opportunities for new or improved products, processes or services" (Pavitt, 2006, p. 88).

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- "Innovation is the process of making changes to something established by introducing something new that adds value to customers" (O'Sullivan & Dooley, 2009, p. 4).

The first thing to note, is that none of these definitions makes it clear how innovation should translate into a science schooling context (Nielsen, forthcoming).

In this chapter, we argue that there can be pedagogically sound way of defining innovation and employability, and that these definitions can be potent in terms of student learning when applied in the planning and implementation of science teaching

Developing a concept of innovation for teaching

While most dictionaries trace the origin of 'innovation' back to the 16th century latin concatenation of 'in' ("into") and 'novare' ("make new") (Stevenson, 2010), Godin's (Godin, 2008) authoritative genealogy traces the term as far back as the thirteenth century – where it denoted changes made to legal contracts. Further, it does seem that the term, until the eighteenth century was consistently used as a pejorative term; denoting dangerous challenges to the existing religious establishment. Most famously, Henry Burton – a seventeenth century puritan minister – was sentenced of 'innovating' and consequently "had his ears cut and was sentenced to imprisonment" (Godin, 2010, p. 3). Indeed, it was not before the mid-nineteen century's industrial revolution that 'innovation' received its' more positive connotation (Godin, 2010). At this time, also disciplines such as anthropology began using the term as an umbrella term for "changes in cultural traits, but also inventions in agriculture, trade, social and political organizations … and technology" (Godin, 2008, p. 25). This represents a shift from using 'innovation' merely to signify something new, to also signifying an aspect of invention or creation leading to (a more or less desirable) change. Similar trends were visible in the field of sociology – in particular in the subfield that studied social change – were some considered inventions as leading to imitations that over time diffuse and lead to social change. Between then and the mid-twentieth century sociologist became more focused on parsing innovation as changes that revolve around technological inventions (Ogburn & Nimkoff, 1964). Thus, in the mid-twentieth century, many sociologists used 'innovation' to signify a process of "technological inventions [that are] used and adopted" (Godin, 2008, p. 31). A contrasting notion parsed innovation as a product – e.g. Rogers (1962) defined 'innovation' as "an idea perceived as new by the individual" (p. 13), and later specified it as "an idea, practice, or object that is perceived as new by an individual" (Rogers, 2010, p. xvii). Still today, innovation is ambiguously used to denote both a process and a product (Gopalakrishnan & Damanpour, 1997). Regardless of whether innovation was parsed as a process or a product, in the mid-twentieth century the term had acquired connotations of creative changes to the established that diffuse and lead to changes. However, the aspect of the individual's creativity was – at least until the 1980's – solely under the purview of psychology (e.g. Sternberg, 1999).

In the twentieth century, a subfield of economics that was concerned with change and dynamics (as oppose to equilibrium – the traditional focus of economists) began to focus on innovation (Godin, 2008). We owe this movement that 'innovation' today often connotes that the established is destructed by something novel (most often a method or a technical product) is commercialized: For example, O'Sullivan and Dooley define innovation as "the process of making changes to something established by introducing something new that adds value to customers" (2009, p. 4). This economist definition of innovation is often traced back to Schumpeter (1934/2004), for whom innovation covers the following five cases: […] the introduction of new goods […] the introduction of a new method of production […] the opening of a new market […] the conquest of a new source of supply […] the carrying out of the new organization of any industry" (1934/2004, p. 66). As such, for Schumpeter, innovation is an activity – or function – of the entrepreneur in his/her quest for "creative destruction" (Pavitt, 2006, p. 105). In many ways, it is this economist rendition of innovation that seems to dominate the public discourse today.

One of the problems that still beset us today is the unfortunate tendency of policymakers and other stakeholders to use 'innovation' and 'entrepreneurship' interchangeably (for a brief discussion of this see e.g. Harding, 2009) – e.g. in the first Danish public mention of 'innovation' in an educational context, innovation was merely treated as the sine qua non of entrepreneurs (Danish Ministry of Education, 1995) – although a number of scholars have insisted on distinguishing between innovation and entrepreneurship (e.g. Fowler, 2000; Hine & Kapeleris, 2006; Megan & Susan, 2005). In order to alleviate this problem, we propose to separate innovation from entrepreneurship in the following way: While innovation signifies the (creative) change to an established practice (often in a valuable way, but not necessarily in the sense of creating an economic value), entrepreneurship is the transformation of a product into economic value (Nielsen, Rump, & Christiansen, 2013; Wennekers & Thurik, 1999).

Clearly, there is a high degree of "fuzziness" to the term 'innovation' (Fagerberg, 2006, p. 21; Nielsen, 2013). This means that when we turn to look at how the term can have meaning in the field of education, the so there is a danger that our discourse will be challenged. As mentioned the term 'innovation' is ambiguous in the sense that it can denote a product or an outcome as well as a process (Gopalakrishnan & Damanpour, 1997), and the features that recent researchers have used to define innovative processes have been very varied. Here are a few samples: "Innovation is the process of making changes to something established by introducing something new that adds value to customers" (O'Sullivan & Dooley, 2009, p. 4), or "innovation, by definition, involves creating and marketing of the new" (Kline & Rosenberg, 1986, p. 275), or innovation is the ability "to see opportunities and to be able to bring these opportunities to life in a value-creating way" (Darsø, 2011, p. 13; my translation), or "[i]nnovation processes involve the exploration and exploitation of opportunities for new or improved products, processes or services" (Pavitt, 2006, p. 88). Clearly, whichever features one focuses on when constructing new curricular will have an impact. Recently, Hobel and Christensen (2012) defined innovation as

an ability in way so as to make it meaningful as the aim of education, and in a way that links up to the traditional notion of Bildung: "Innovation signifies that of rethink and improve (that is, not just change) an existing practice in the world in an ethically defensible fashion with actors that are influenced by and act in that practice on the basis of relevant knowledge" (p. 57). As such, this may be the most stringent definition so far of innovation in an educational setting.

In a recent study (Nielsen, forthcoming) of how expert teachers in upper secondary school talk about which criteria should be used for assessing innovation competence, it was documented that these expert teachers point to five generic sub-competences all at play in innovation processes revolving around authentic issues from a practice (often involving stakeholders from that practice):

- *Creativity*: The extent to which the student can find, not just idiosyncratic ideas/solutions, but a range of different ideas/solutions, and then sort, prioritise, and extend selected ideas/solutions.
- *Collaboration*: The extent to which the student can take responsibility for a group finishing a task, and be inclusive and versatile when it comes to group work – e.g. by demonstrating that she can utilise how the skills and knowledge of others complement her own.
- *Navigation*: The extent to which the student can use her disciplinary background to decode a task or an issue; assess which information is critical for solving a task/addressing an issue; and take ownership of and plan complex work process.
- *Action*: The extent to which the student can implement her ideas; assess and take risks; and collect information from other sources than the classroom.
- *Communication*: The extent to which the student can analyse how to communicate to a specific target group; can master different communication techniques and methods; and can communicate in an engaging and convincing manner.

This study, while not representative at a large scale, provides a detailed glimpse into how expert teachers think about the aims of education for innovation (Nielsen, forthcoming). Most importantly, from this study it was clear that teachers were hesitant to assess their students in terms of whether or not the students' ideas/solutions to authentic issues potentially created value for (that is, improved) a given practice. Rather, the teachers in this study focused on whether the student could reflect upon, and justify their claims regarding, the potential value-creation for the practice involved (Nielsen, forthcoming). As such, it could make sense to speak of preparatory innovation competence as a goal for education – where this would mean that the educational system should teach students to go through specific processes (in which they attempt to improve on issues from authentic practices) in specific ways (by being able to be creative, collaborate, navigate, act/implement, and communicate at the proper phases in the process).

Based on this, we could hone in on education for innovation in the following way: Education for innovation signifies teaching and learning aimed at fostering the competency to, individually or together with others, and on the basis of relevant knowledge, (a) generate ideas or solutions to an issue from an existing practice; (b) to asses these ideas in terms of their utility, realizability, and value-creation potential; (c) to implement selected ideas, possibly in sketch-form; and (d) to communicate ideas to different stakeholders.

While resembling inquiry or project-oriented teaching and learning, teaching for innovation goes one step further: But prototypical pedagogical approaches that foster innovation and/or employability go beyond problem-oriented project work and inquiry teaching, because teaching for innovation and/or employability implies that the students' ideas or work are not just assessed from a disciplinary perspective, but also against the yardstick of the practice-in-reality that they are about (at least when letting students work in innovation processes). The world speaks back to the students. Their production/activities are not only assessed on the basis of scholastic merit. The didactical contract implies that the productions/activities of the students are not just for the benefit of the teacher or the assessment. While this is possible in both problem-oriented project work and inquiry teaching, it is probably not always the case in practice.

Developing a concept of teaching for employability

Employability is a notion that is heavily embedded in the historical and cultural development of the society, which produces different meaning of what employability is and how it should be used. This section will portray the plateaus in the history of employability and decipher the different meanings embedded in the notions throughout the historical phases it has encountered. The development can roughly be categorized into three waves (Gazier, 1998a).

The concept of employability first appeared a century ago and was primarily used until the beginning of the Second World War (Gazier, 1998b). Here the meaning of employability was those who were willing and able to work and those who were not. Employability was perceived as a tool of diversion of the workforce. As such, being employable was a question of the individuals' health and habits – e.g. being sober at work – but also motivation and mind-set.

The second wave appeared in 1950s and 1960s. Here employability was used to label and identify and measure the distance between the individual and the labour market. In particular, the focus was on the social, physical or mental deficits of individuals that made them unfit for employment (McGrath, 2009). Hereunder disadvantaged groups and the abilities they lacked to gain a job. Through the 1960s, fluctuations in the labour market produced an extended understanding of the notion acknowledging that employability also had to do with the probability for a person to find a job.

Finally the human resources approach appearing in the late 1980s introduced an approach to employability as career development in a labour market characterized by constant changes demanding of the workforce to be flexible. Employability is no longer an instrument to get people into work, or a tool to measure the deficits of the

employee, but an instrument to support the employee to adjust to the need of the labour market. A successful career requires the development of skills that are transferable to a flexibility labour market where shift in between jobs were expected (Gazier, 2001). Now employability is connoted to the capacity of individuals and perceived as the individual's own responsibility and interest in optimizing personal competences.

We perceive this evolution of the concept as cultural embedded in the general development in society where todays' individuals in various areas are expected to govern themselves instead of being controlled by external demands.

The individual is to become, as it were, an entrepreneur of itself, seeking to maximize its own powers, its own happiness, its own quality of life, through enhancing its autonomy and then instrumentalizing its autonomous choices in the service of its life-style (Rose, 1998, p. 21)

An illustration of the phenomena is the balance between work life and family life, which is perceived as primarily being a challenge of each individual. Each employee in the knowledge society is required to find her own way of making sense and balancing the challenging relation as long as it is done in way that is recognized as profitable by the employers (Kossek & Lambert, 2012).

Employability is no longer an instrument to get people into work, or a tool to measure the deficits of the employee, but an instrument to support the employee to develop herself in a favourable way, which is recognised as attractive by the labour market. The Foucauldian notion of governmentality can be used to understand this progress of the concept of employability. Governmentality describes a historically change in the way power exerted over the individual, from being an open external control and exercise of power, to a situation where the individual incorporates the power and exercise it on themselves (Foucault, 1997a, 1997b). As such it is the individuals own interest to become employable and their responsibility to develop themselves in a way that is demanded and perceived to be attractive by their employers.

However, this discourse of employability is facing competing discourses, that negotiates the way that meaning is ascribed to the notion. The next session will present some of those meanings that are embedded in employability today.

Employability is a difficult notion to define clearly. It is like a piece of soap between wet hands. Thus, we are interested in how different meanings of the concept of employability produce social techniques and discursive influences, which set the scene for higher education thinking in particular ways.

In society in general, and by the government in particular, employability is used as an indicator of an individual's chance of employment. From the point of view of the employer, employability is perceived as an indicator of meeting the supply and demand of the labour market. From the point of view of the individual, employability is an indicator of gaining an attractive career (Forrier & Sels, 2003).

Also within research, a range of different meanings are embedded in the concept. Recent definitions of employability have tended to focus on the abilities of the

individual – labelled as internal employability (Forrier & Sels, 2003; McQuaid & Lindsay, 2005). Yorke (2006) proposed that employability should be defined as 'a set of achievements – skills, understandings and personal attributes – that makes graduates more likely to gain employment and be successful in their chosen occupations, which benefits themselves, the workforce, the community and the economy' (Yorke, 2006, p. 8). Another perception of employability is external employability factors of the labour market, socio-economic variables or within-organisation factors that effects the employment situation. An example is how the level of unemployment interacts with what is considered to be employability.

Thijssen et al. (2008) suggest three related conceptual components of employability. 1. The most basic definition relates to personal adequacy to perform a job. Employability is perceived as the radius of the individuals' possibilities to perform a variety of jobs properly. 2. The second definition builds upon the first in terms of including personal competencies, hereunder in particular learning and career competencies. In this perception employability determines whether an individual are capable to use opportunities beyond their current employability radius. 3. The third definition includes the cultural context in where the employability is embedded. It includes all the factors that in relation to personal factors have influence the future labour situation of workers. Most literature addresses employability as a combination between one and two, while the third concept is more rare.

As the concept of employability is brought into higher education, a range of challenged arise. One of the major concerns has been how the purpose of higher education to promote wisdom and knowledge conflict with the logic of the labour marked' and hence the interest in accumulating value. Therefore it is not a simple task to bring employability into university education. First, the competences required in a job might be context-specific and hard to learn in an educational context (Lave & Wenger, 1991). Second, the university institutions and the industries are driven by various motives, why the employability might be challenging for the students to transform (Hennemann & Liefner, 2010); i.e. even if they learn how to manage a project during their studies – managing a project in real life industries might be different. Finally, the students do not approach the labour market in uniformed ways (Fugate, Kinicki, & Ashforth, 2004), which requires universities to include various ways of fostering employability.

Employability could be incorporated into the curriculum in a range of ways: It can be incorporated through planned collaboration with external actors as suggested above but also and more importantly it can be addressed through everyday practices in upper secondary school and at the university. The latter was evident in a recent evaluation of a regional development project that seeks to reorganise teaching in upper secondary school in Denmark with a focus on foster new innovation competences. It was found that students who primarily learn in a project oriented fashion in all disciplines in upper secondary school to a notable degree were much more reflective (than students who experience teacher-centred teaching) about what they can use their gained competences for (Nielsen, 2014).

From being implicitly embedded in the curriculum, employability must be reached through learning processes that depart from core academic knowledge and is included in the assessment as intended learning outcomes. Learning activities that support student employability will be quite similar to the ones that seek to foster innovation and to recommended higher education learning activities in general. In particular, activities that seek to foster employability would be activities in which the student is required to apply meta-reflection of learning (learning how to learn), practice transferability of knowledge, adjust approaches to different learning situations and learn self-management and be able to work independently as well as in groups to highlight the ones we find to most crucial (Knight & Yorke, 2013).

Discussion and Concluding Remarks

We have tried to make the case that the present dominant discourse surrounding innovation and employability is heavily market-oriented and primarily governed by values and principles from economics. But we have also indicated that the dominant discourse surrounding innovation an employability can be challenged and that a different meaning can be embedded in the notions – and that meaning affords pedagogically meaningful teaching and learning.

Thus, we want to claim that science teaching that focuses on fostering employability or facilitate innovative processes on the side of the students can be useful for a number of reasons. Indeed, science teaching activities that lead to some concrete new creations that are should be valuable to some one would have immense potential. The same is true for science teaching activities that focus on strengthening the employability of students in the form of increasing their meta-reflection and flexibility vis-á-vis applying their competences or acquiring new knowledge and skills. Clearly, when students work on issues in the ways proposed here has the potential to make the related chemistry learning relevant for the students (a quality that is in high demand; e.g. EU-Commision, 2004). Further, the notion that students work on real issues and that their solutions should have an actual value for some one could be seen as a exemplary versions of types of learning that are presently heralded – e.g. discovery learning, inquiry learning, or, more generally, problem-based learning. Essentially, we think that a pedagogical focus on fostering students' innovation competence and employability resonates neatly with Gibbons' (1997) ideas of knowledge production in the 21st century: The idea that knowledge is increasingly "transdisciplinary" and that it is "worked out in the context of application" (p. 3).